

MEETING ABSTRACT

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Attenuation correction synthesis for hybrid PET-MR scanners: validation for brain study applications

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From PSMR14: 3rd Conference in PET/MR and SPECT/MR
Kos Island, Greece. 19-21 May 2014

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In this work, we further validate a CT and attenuation map (μ -map) synthesis algorithm [1].

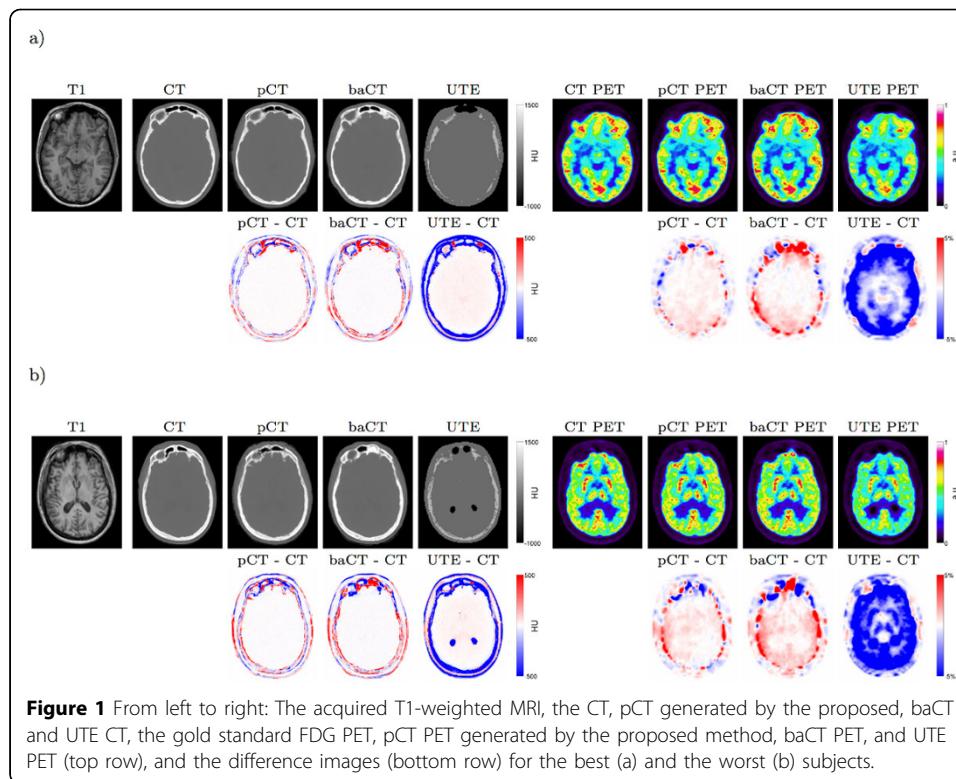
The CT synthesis method relies on a pre-acquired set of aligned MRI/CT pairs from multiple subjects. Each MRI from the database is non-rigidly registered to the target MRI. The CTs in the database are then mapped using the same transformation to the target MRI. A local image similarity measure between the target MRI and the set of registered MRIs is used as a surrogate of the underlying morphological similarity. Finally, the synthetic CT is generated using a voxel-wise weighting scheme, and converted to linear attenuation coefficients by a piecewise linear transformation.

Following the proposed method, a pseudo CT (pCT) was generated using only the MRI of the subject and compared to the ground truth CT, validating the accuracy of the CT synthesis. A PET image (PET_{pCT}) was then reconstructed with an off-line version of the Siemens Healthcare reconstruction software using the pCT μ -map, and compared with the gold standard PET reconstructed using the CT μ -map.

We validated our method for brain-related applications with 16 subjects and compared our solution to: a simpler atlas-based method, named the best-atlas method,

Table 1 Average and SD of the mean absolute residual $(MAR = \left(\sum_V |GT_v^{CT} - I_v^{CT}| \right) / V)$ **and mean residual** $(MR = \left(\sum_V (GT_v^{CT} - I_v^{CT}) \right) / V)$ **between the ground truth CT and both the pseudo CT, best-atlas CT (baCT) and UTE CT (left column); average and SD of the relative MAR and relative MR between the gold standard CT PET and both the pseudo CT, best-atlas CT and UTE PETs (right column).**

		CT (HU) - Head			PET (%) - Brain		
		pCT	baCT	UTE	pCT	baCT	UTE
MAR	Average	107	128	218	2.35	3.03	12.72
	SD	11.8	13.3	23.2	0.71	0.49	1.55
MR	Average	-7.2	18.0	-143	0.70	0.88	-12.61
	SD	14.9	16.3	35.0	1.32	1.45	1.60



obtained using a global similarity measure to select, from the database, the most similar template; and to the prototype version of a UTE-based method currently implemented on the first software versions of the Siemens Biograph mMR hybrid PET/MR scanners. The results presented in Table 1 demonstrate that the mean residual estimated between the PET_{pCT} and the gold standard PET is significantly smaller compared to the other methods. More accurate results are reached with the proposed method compared to the best-atlas method, which demonstrates the advantages of synthesising CTs at a local scale instead of a global scale (Figure 1).

Acknowledgements

This work was supported by an IMPACT studentship funded jointly by Siemens and the UCL FES. The Dementia Research Centre is an Alzheimer's Research UK Co-ordinating Centre and has also received equipment funded by Alzheimer's Research UK and Brain Research Trust. Funding was received from the EPSRC (EP/H046410/1, EP/J020990/1, EP/K005278), the MRC (MR/J01107X/1), the EU-FP7 project VPH-DARE@IT (FP7-ICT-2011-9-601055) and the NIHR Biomedical Research Unit (Dementia) at UCL. This work was also supported by researchers at the NIHR UCLH BRC (including the High Impact Initiative).

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Published: 29 July 2014

Reference

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doi:10.1186/2197-7364-1-S1-A52

Cite this article as: Burgos et al.: Attenuation correction synthesis for hybrid PET-MR scanners: validation for brain study applications. *EJNMMI Physics* 2014 1(Suppl 1):A52.